# SOIL INVESTIGATION
# STEVENS CREEK

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File No. CO-0952-C1
October 24, 1980

Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, California 95118

Attention: Mr. David M. (Mike) McNeeley, Division Engineer
Mr. Joe Pandit, Associate Civil Engineer

Subject: Stevens Creek,
Homestead Road to Central Avenue
SOIL INVESTIGATION

Gentlemen:

We are pleased to transmit in the accompanying report the results of our Soil Investigation for the subject project. Under separate cover we are transmitting one 22x36" drawing showing the logs of test borings.

While this completes our work under the current contract, we will continue to be available to discuss the investigation with you and the District at your convenience. Please feel free to call if you have any questions.

Very truly yours,

EARTH SYSTEMS CONSULTANTS

Albert C. Gribaldo, C.E. 8412

tsw

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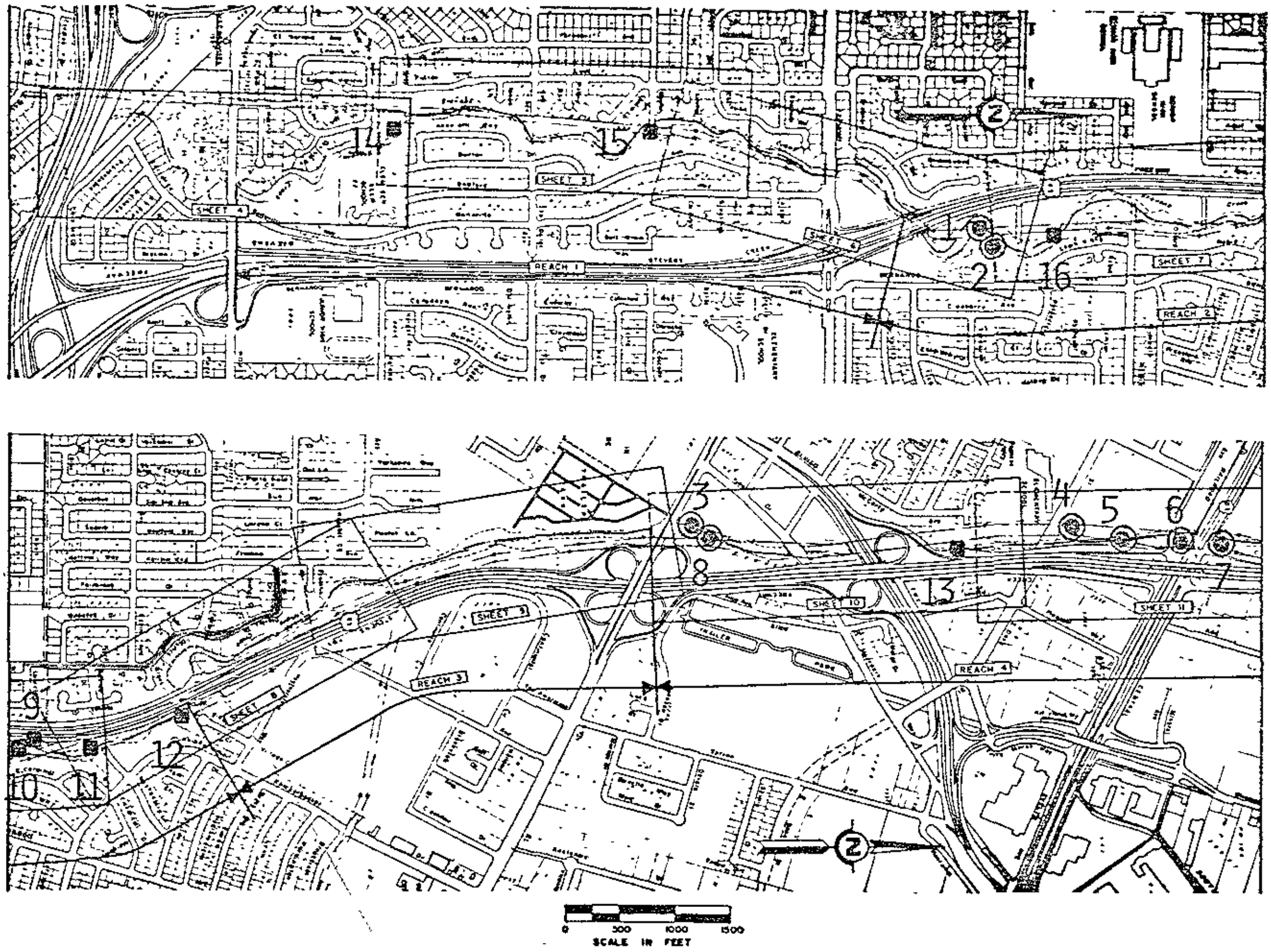
# SOIL INVESTIGATION

## INTRODUCTION

This report presents the results of a soil investigation conducted for developing design parameters for the proposed Stevens Creek Improvements in Mountain View, California. The subsurface and surface conditions expected to be encountered along the creek alignment are shown in the logs of test borings excavated during the field investigation, in the bank profiles at locations where hand sampling was performed, and in the results of the tests subsequently performed. Recommendations for design of the erosion protection devices and data for the design and construction of safe excavations for two 10-foot diameter pipes are presented in the text of the report.

### Project Design

The proposed Stevens Creek Improvements consist of various installation and repair of erosion protection devises along the east and west sides of Stevens Creek from Homestead Road, north to Central Avenue (see Figure 1, Site Plan). The improvement area is approximately 24,000 feet in length and is a part of an overall improvement of the Stevens Creek channel area between Junipero Serra Highway and Whisman Slough. The overall improvements are planned in stages and as such will tend to improve the conditions in some areas to provide additional needed margins of safety from continuing erosion.



LEGEND

◉ Boring Location and Number

■ Sampling Location Profile
and Number

SITE PLAN

Stevens Creek
Station 21+00 to 262+00

Figure 1

## Procedures of Investigation

Work performed for this investigation included: project planning; preliminary and detailed reconnaissance along the alignment; a review of existing information; a subsurface investigation, including excavation of test borings and hand sampling at various locations; a laboratory testing program to determine the physical characteristics of the soils encountered along the alignment; engineering interpretation and evaluation of the results of field and laboratory investigations and tests; the formulation of recommendations based on these evaluations; and the preparation of this report.

# INVESTIGATIVE PROCEDURES AND RESULTS

## Drilling and Sampling

Eight test borings were drilled at this site between August 29 and September 12, 1980. The borings were made with a truck-mounted rig, using 6-inch diameter continuous flight augers. The borings ranged in depth from 15.0 to 39.0 feet below the existing ground surface.

As the borings were advanced, the soils were visually classified and logged by a Soil Engineer. Relatively undisturbed soil samples were recovered at selected intervals, using a 3.0-inch O.D. Modified California Split-Barrel Sampler containing 6-inch long brass liners. Disturbed bulk samples were also obtained at selected intervals. The Sampler was advanced into the undisturbed soil by means of a standard 140-pound driving hammer falling 30 inches.

Resistance to sampling penetration was recorded as the number of hammer blows per foot of penetration. For the 3.0-inch sampler, the penetration resistance was converted to "N" values equivalent to those obtained by the Standard Penetration Test. Logs of all eight borings, showing the location of drive samples and the penetration resistance, are presented on Figures A-1 through A-12 of Appendix A.

In addition to the test borings, selected locations along the existing channel banks were visually logged and both undisturbed shelby tube and disturbed bulk samples were obtained from the exposed banks. Graphic representation of the profiles along with approximate sample locations are presented on Figures A-13 and A-14 of Appendix A.

## Laboratory Testing

Laboratory tests were performed on selected samples of the soils encountered in the borings and at hand sampling locations to determine the physical and engineering characteristics pertinent to this investigation. Tests were also performed on bulk samples of representative soil materials.

In-place dry density and moisture content were determined for most of the "undisturbed" samples, by weighing a known volume of soil before and after oven drying.

Strength characteristics of the soils were determined from the results of direct shear tests and unconfined compression tests. Shear test specimens were prepared for testing by placing them in contact with water for at least 24 hours prior to testing. Shearing was done under normal loads ranging up to 3,000 p.s.f.

A compaction curve (ASTM D1557-70) was performed on a selected bulk sample. The grain-size distributions of selected representative samples were determined by wet sieve analysis for all sieve sizes through the 270 sieve or by hydrometer analysis. The results of these tests and other laboratory tests are summarized on Tables A-1 and A-2 of Appendix A.

## SITE CONDITIONS

### General Description along Alignment

Stevens Creek follows a well defined meandering channel trending generally north from the foothills to San Francisco Bay. Major tributaries feed the existing creek north of Stevens Creek Reservoir. The area covered by this investigation, from Homestead Road to Central Avenue, is a relatively deep cut trapezoidal channel with generally well vegetated sides. Design flows of 6,140 c.f.s. at 1% flood indicate significant carrying capacities. Stevens Creek is the major flood control channel in the northwest zone of the Santa Clara Valley Water District.

### Soil Conditions

As noted on the logs of test borings and profiles, the materials encountered were predominantly interbedded clayey sands and sandy clays. Isolated layers of gravelly sands with clay binder and having some cobbles and lesser small boulders were noted. The coarser grained soils, when encountered, tended to be concentrated within the upper 10 feet below the banks and at the channel bottom along the project alignment.

Some fill was encountered at Boring No. 6 and Profile 15. The fill at Boring No. 6 contained some debris and appears to be old "railroad" fill. Along Profile 15 the fill extended the entire height of the bank and east an undetermined distance.

### Groundwater

True groundwater was not encountered, however in Boring No. 8, seepage occurred due to the proximity of the test boring within the channel bottom. This was perched water, charged by upstream sources and flowing within the coarse bottom soils. Since construction time may be during wet periods, the prolonged dry period which preceded our investigation must be taken into consideration when interpreting this data at a future date.

## GENERAL CONCLUSIONS

The following findings and conclusions are based on the data gathered and analyzed during this investigation. Basic parameters were assumed for the slope stability analysis, among them: 1) a free draining condition within the soils; 2) no surcharge or tension cracking at the top of the slope; and 3) static water level below the potential failure plane. Preliminary plans prepared by the District indicated desired slope angle of protected areas with an indicated maximum scour depth of 3 feet. When this scour depth was used in our slope stability evaluation, there were areas where the desired slope angles would not meet acceptable static slope stability safety factors. Based on this we have recommended flattening the slopes as reflected in the typical section included for Reach 2.

It is difficult to establish by any analytical process the rate or probable extent of potential scour. The majority of soils as evaluated are susceptable to moderate erosion at velocities greater than 5 feet per second, however, the effect velocity has on scour is questionable and is heavily influenced by whether the oncoming flow is sediment-transporting or not. The best available evidence is that past performance appears to indicate that the flow has equilibrium sediment loads and therefore only moderate scour potential. In this case where streambed sands have normal specific gravity, a maximum depth of protection of 5 feet is common practice. Further evaluation of scour potential is outside the scope of this report.

In consideration of above parameters the investigation revealed no geotechnical factors which, in our opinion, would preclude the installation of the proposed improvements provided that the recommendations of this report and the regulations and codes of the appropriate governmental agencies are implemented.

## DESIGN CONSIDERATIONS AND RECOMMENDATIONS

### Slope Stability - Reaches 1 and 4

The soils encountered along Reach's 1 and 4 are generally classified as hard cohesive sandy clays, silts, and dense clayey sands. Existing slopes are near vertical to approximately one horizontal to one vertical.

Slope stability analysis conducted using data from direct shear tests indicate that slopes protected by Sacked Concrete Lining may be constructed at an angle of 3/4 horizontal to 1 vertical (or flatter) for the protected portion of the slope. Above the sacked concrete slope protection, the exposed soils should be trimmed back to 1 horizontal to 1 vertical (or flatter). This is graphically illustrated by Figure 2, page 10.

Rock Lined Slopes should be laid back to 1 horizontal to 1 vertical as detailed on Sheet 18 of 18 "Typical Erosion Protection Measures" of the contract plans. Refer to section "Fill Blanket" for additional recommendations.

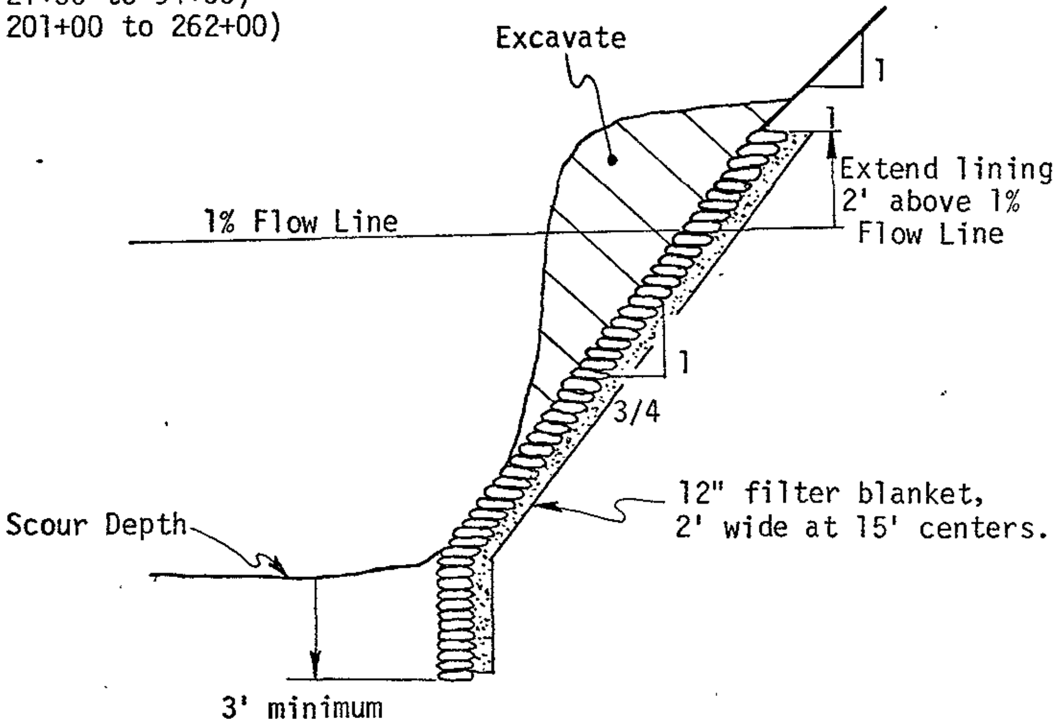
### Slope Stability - Reach 2

The presence of substantially cohesionless materials found along Reach 2, between Stations 94+00 and 151+00 precludes the use of 3/4:1 slopes, even with adequate erosion protection.

It is recommended that slopes using both Sacked Concrete Lining and Rock Lining be laid back to 1:1 (or flatter). The natural exposed soils above the lining should be regraded at an angle of 1½:1 (or flatter). Typical sections are shown on Figure 3, page 11, for the sacked concrete lining.

## TYPICAL SACKED CONCRETE LINING FOR SLOPES STEEPER THAN 3/4:1

Reach 1 (Station 21+00 to 94+00)
Reach 4 (Station 201+00 to 262+00)


Excavate
1
1
Extend lining 2' above 1% Flow Line
1% Flow Line
1
3/4
12" filter blanket, 2' wide at 15' centers.
Scour Depth
3' minimum

## TYPICAL SACKED CONCRETE LINING FOR SLOPES FLATTER THAN 3/4:1

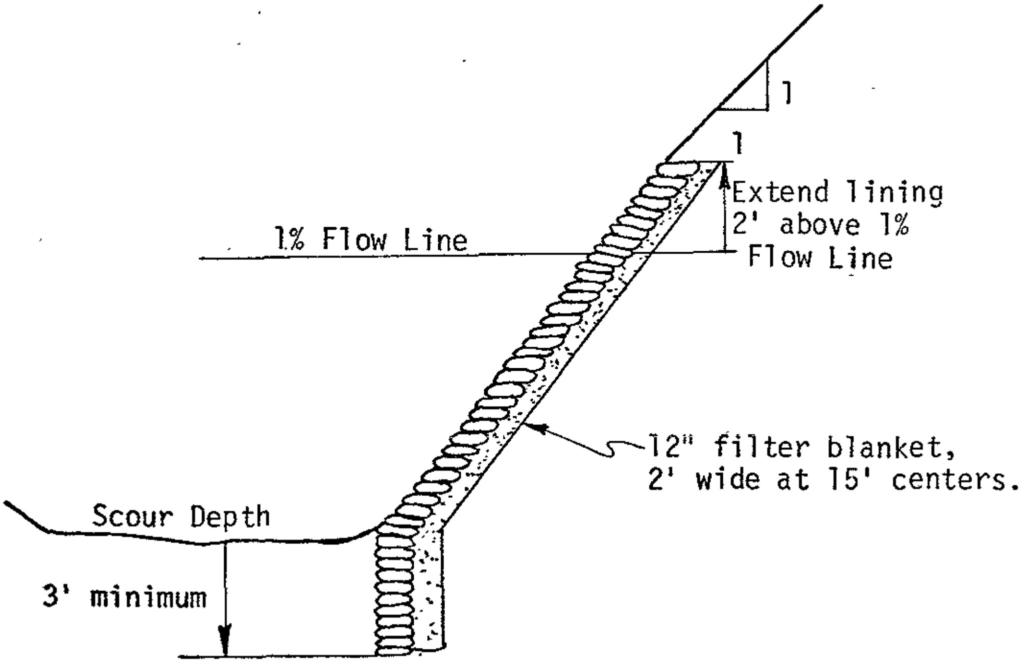
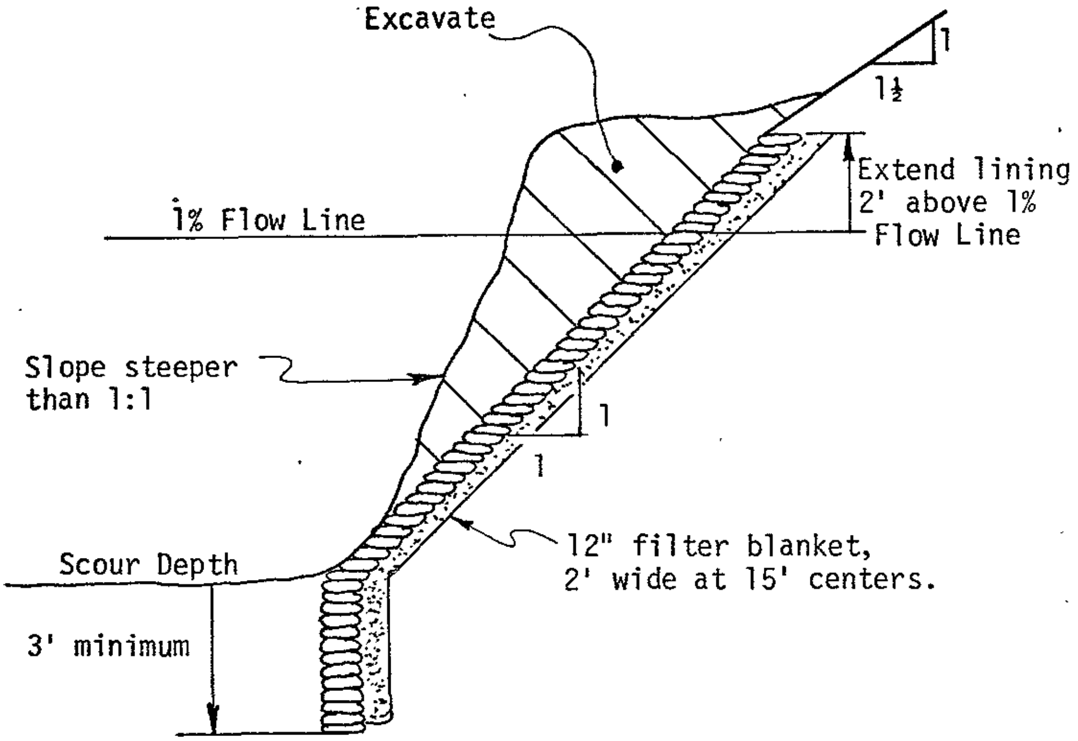
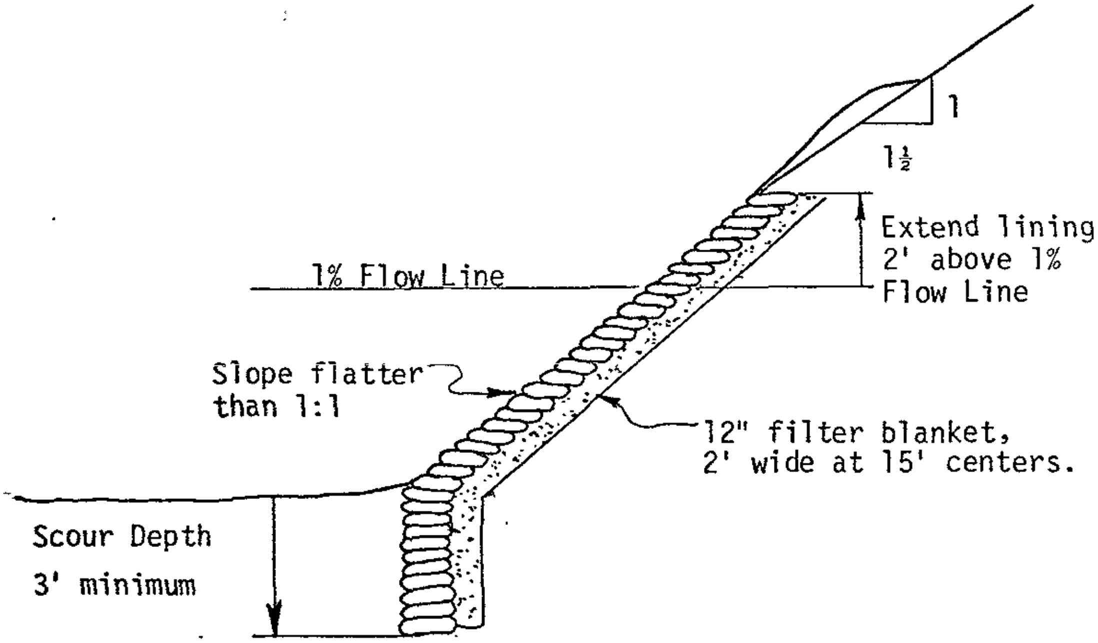

1
1
Extend lining 2' above 1% Flow Line
1% Flow Line
12" filter blanket, 2' wide at 15' centers.
Scour Depth
3' minimum

Figure 2



TYPICAL SACKED CONCRETE LINING FOR SLOPES STEEPER THAN 1:1

Reach 2 (Station 94+00 to 151+00)



TYPICAL SACKED CONCRETE LINING FOR SLOPES FLATTER THAN 1:1

Figure 3

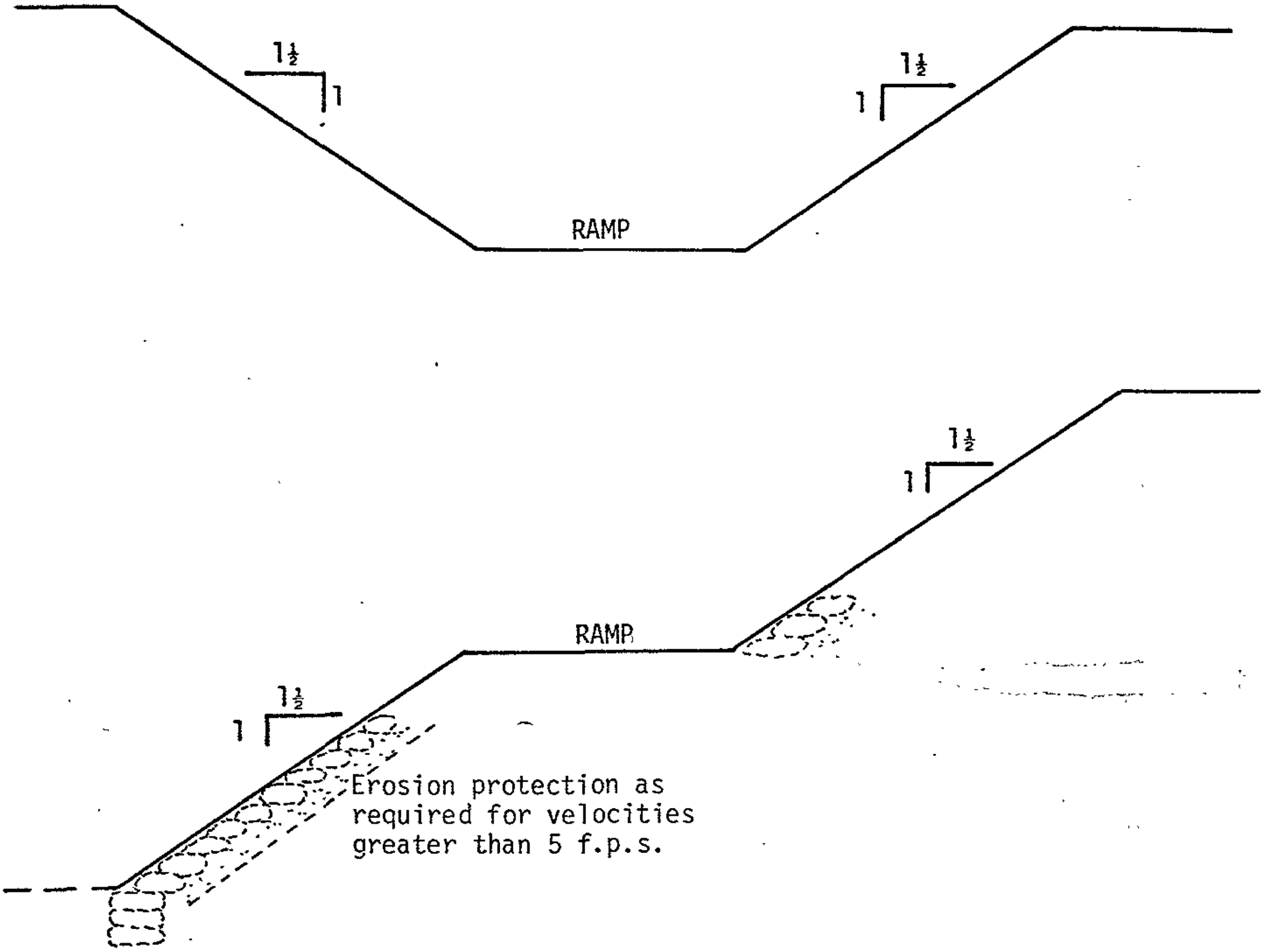
## Ramp Installation

Installation of new access ramps and/or repair of existing ramps are proposed at approximate Stations 66, 83, 121, 246 and 260. In addition, a gabion lined ramp is proposed for the area just north of El Camino Real (Station 205+).

Generally, the soils in the areas of the proposed ramps are cohesive in nature, however they are susceptable to moderate erosion at velocities greater than 5 feet per second. Isolated layers of cohesionless soils can be found along these areas and erodability of these soils is classified as high, with major undercutting occurring at velocities as low as 2 feet per second. Based on this data, erosion protection is highly recommended in areas with velocities of 5 feet per second or greater in areas deemed critical for access.

Typically, unprotected side slopes should be stable at angles of 1½:1, as indicated on Figure 4, page 13. The ramp proposed at Station 205 will be protected by gabions and as such slopes may be constructed at an angle of 1:1, as indicated on Figure 5, page 14.

Profile 15, taken at approximately Station 65+50 indicated the presence of very loose end dumped fill along the creek bank. The lateral extent of this fill is unknown. During construction of the ramp in this area, all loose fill must be removed to firm natural soils under the observation of the Soil Engineer. The ramp may then be excavated in the firm natural exposed soils or the removed soils may be replaced as structural fill and the ramp constructed within the fill. Refer to Figure 4, page 13 for typical section.

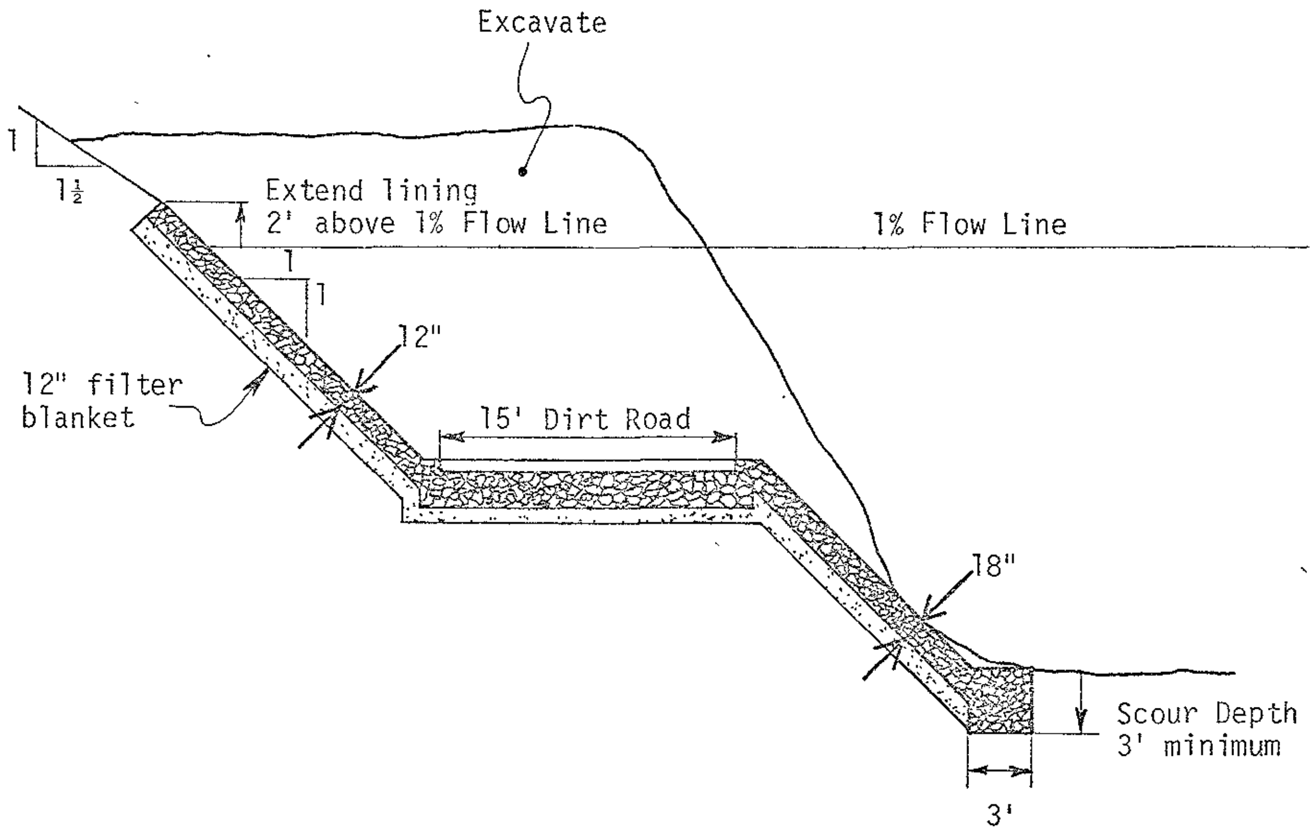


Erosion protection as required for velocities greater than 5 f.p.s.

RECOMMENDED SLOPES AT PROPOSED RAMPS AND RAMP IMPROVEMENTS

Approximate Station 66 (possible existing fill - see text)
Approximate Station 83
Approximate Station 121
Approximate Station 246
Approximate Station 260

Figure 4



GABION LINED PROTECTION / NORTH OF EL CAMINO REAL

Figure 5

## Filter Blanket

To preclude the migration of subsurface soils into and/or through the proposed rock lining and gabions placed for erosion protection it is recommended that a filter blanket be provided between the native soil and the rock lining and/or gabions. This filter should consist of a minimum 12-inch thick layer of Class 2 Permeable filter material conforming to Section 68-1.025, or 3/4-inch combined concrete aggregate meeting Section 90-3.04, both of the California Standard Specifications.

In lieu of the graded filter material, an acceptable filter cloth in combination with a non-graded granular blanket placed between the rock lining/gabions and the natural soil may be used. Proper cloth and blanket installation will allow the passage of water, but preclude the migration of soil.

## Erosion Protection Design

Creek velocities of 5 feet per second or greater will necessitate positive erosion protection devices to preclude scour and undercutting of existing banks and structures. Soils exposed along the creek banks and bottom are susceptable to erosion at moderate velocities and without protection, erosion can be expected to occur and continue. Economics dictated that complete protection is not feasible and therefore, only specific areas are proposed for improvement at this time.

Typically, erosion protection devices installed in accordance with the recommendations of the previous section on "Slope Stability", with scour depth protection of a minimum of 3 feet below existing channel, and both up-stream and down-stream cutoff trenches should reduce current erosion problems. The strength characteristics of proposed sacked concrete and rock or gabion linings have been considered in the recommended slope angles and as such steeper slopes are not recommended.

Physical design of slope protection may be based on an active pressure of 40 p.c.f. equivalent fluid weight for free draining conditions. Passive pressures acting at the toe of existing banks, assuming resistance within the channel soils, should be limited to 250 p.s.f./foot of depth. However, due consideration should be given to proposed scour depths.

## Levee Construction

A new levee berm is proposed between Stations 240+00 and 249+50 to raise the existing west bank above the 1% flood level. Additionally, it is proposed to widen the existing levee along the west bank between Station 252+00 and 260+00.

Generally, the soils underlying the proposed levee construction are capable of adequately supporting the additional weight without adverse settlements. Excavated soils from construction improvement areas within the project boundaries are suitable for use as compacted fill providing all vegetable and other deleterious materials are first removed. Sandy soils should be mixed with other soils containing sufficient clay or binder for use in the levees to enhance their erosion resistance, however velocities greater than 4 f.p.s. may cause substantial erosion and/or undercutting of berms unless positive erosion control measures are taken such as sacked/rock lining, etc.

In areas of proposed filling, surface organics should be stripped. The exact depth or amount of stripping should be determined by the Soil Engineer in the field during grading operations based on surface conditions prevailing at that time. Areas directly outside of the filled areas should be left as much as possible in their natural vegetated state so some erosion protection will be maintained. After stripping, exposed soils should be scarified approximately 8 inches deep, moistened or dried to near optimum moisture and mechanically compacted.

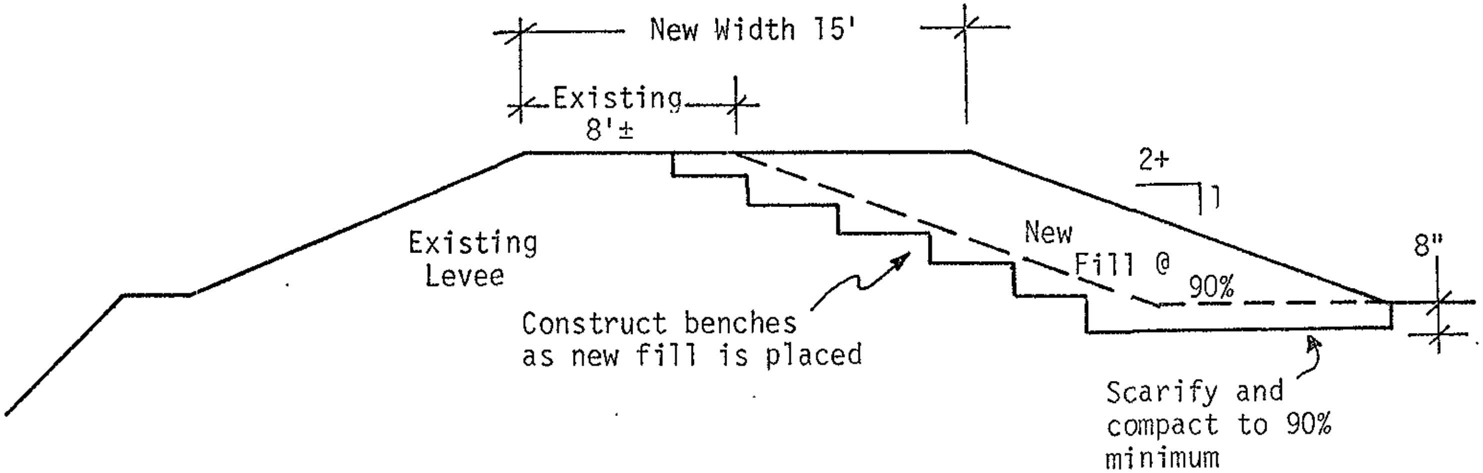
Fill soils should be placed in their (6-inch) layers on the approved subgrade, compacted at a moisture content near optimum and tested as fill progresses. During placement of fill to widen the existing levees, benches should be constructed into the existing slope to create a positive bond between the new and the old fill.

Engineered fills should be compacted to at least 90% relative compaction based on the ASTM D1557-70 Laboratory Compaction Test Procedure. Typical sections are shown on Figure 6, page 18.

## Bypass Pipe Installation

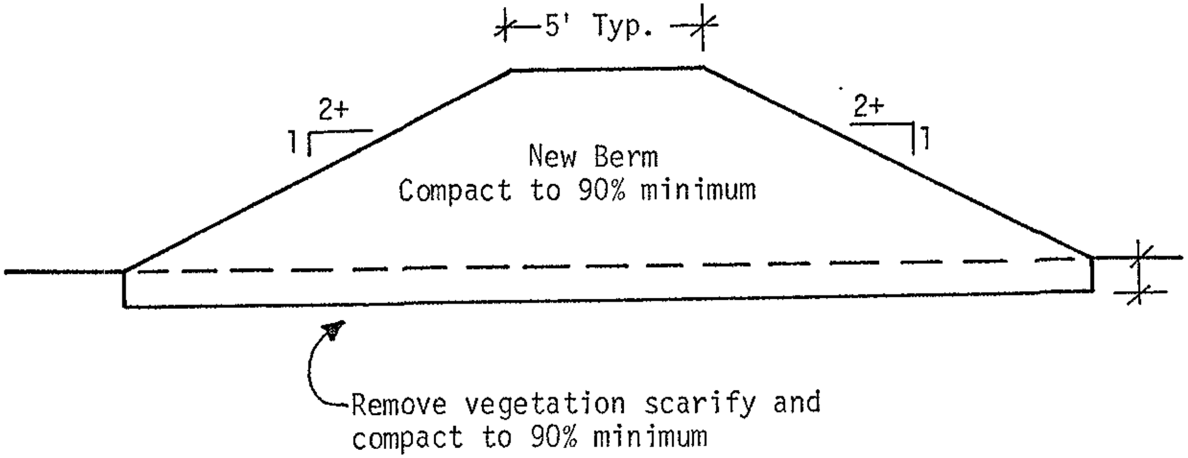
Two 10-foot diameter pipes are proposed for a bypass beneath Evelyn Avenue, the Southern Pacific Railroad and Central Expressway, approximately Stations 247 to 251. It is our opinion that due to the shallow cover and dynamic loading conditions, reinforced concrete pipe (RCP) or heavy steel casing are the most feasible for installation in this area.

Installation of the bypass pipes can be divided between cut and cover, and jacking methods. Cut and cover methods may be used between approximately Stations 247+00


New Width 15'
Existing 8'±
2+
1
Existing Levee
New Fill @ 90%
8"
Construct benches as new fill is placed
Scarify and compact to 90% minimum

TYPICAL SECTION FOR WIDENED LEVEES

Approximate Station 252 to 260



TYPICAL SECTION AT NEW BERM

Station 240+00 to 249+50

Figure 6

to 249+00, Evelyn Avenue to the S.P.R.R. Jacking will be necessary between Stations 247+00 to 247+80 (Evelyn Avenue) and 249+00 to 251+20 (S.P.R.R. and Central Expressway). Vertical shafts may be sunk to the design level of the pipe at approximate Stations of 246+80, 247+00, 249+80 and 250+60 for jack frames or alignment revisions.

Excavation conditions are favorable along the proposed alignment and no exceptionally difficult conditions exist which would justify an alignment change. Bedrock or cemented soils were not found along the alignment, so blasting or ripping is not anticipated. Minor rock may be encountered. However, when related to the size of pipe and therefore the size of excavating equipment, little difficulty with excavating is anticipated.

The granular nature of the soil could result in local collapse of the trench walls along any part of the alignment. Shoring should be contemplated along any part of the alignment. Particular attention must be given to the fill areas and areas where seepage may occur. The contractor should adhere to the requirements of Title 8 of the Division of Industrial Safety Construction Orders. This governs the requirements and responsibility for worker protection in trenches. The contractor should be made responsible for the protection of utilities or other structures adjacent to the excavations which could be damaged by moving ground.

Typical temporary trench and backfill requirements for the cut and cover section are noted on Figure 7, page 20.

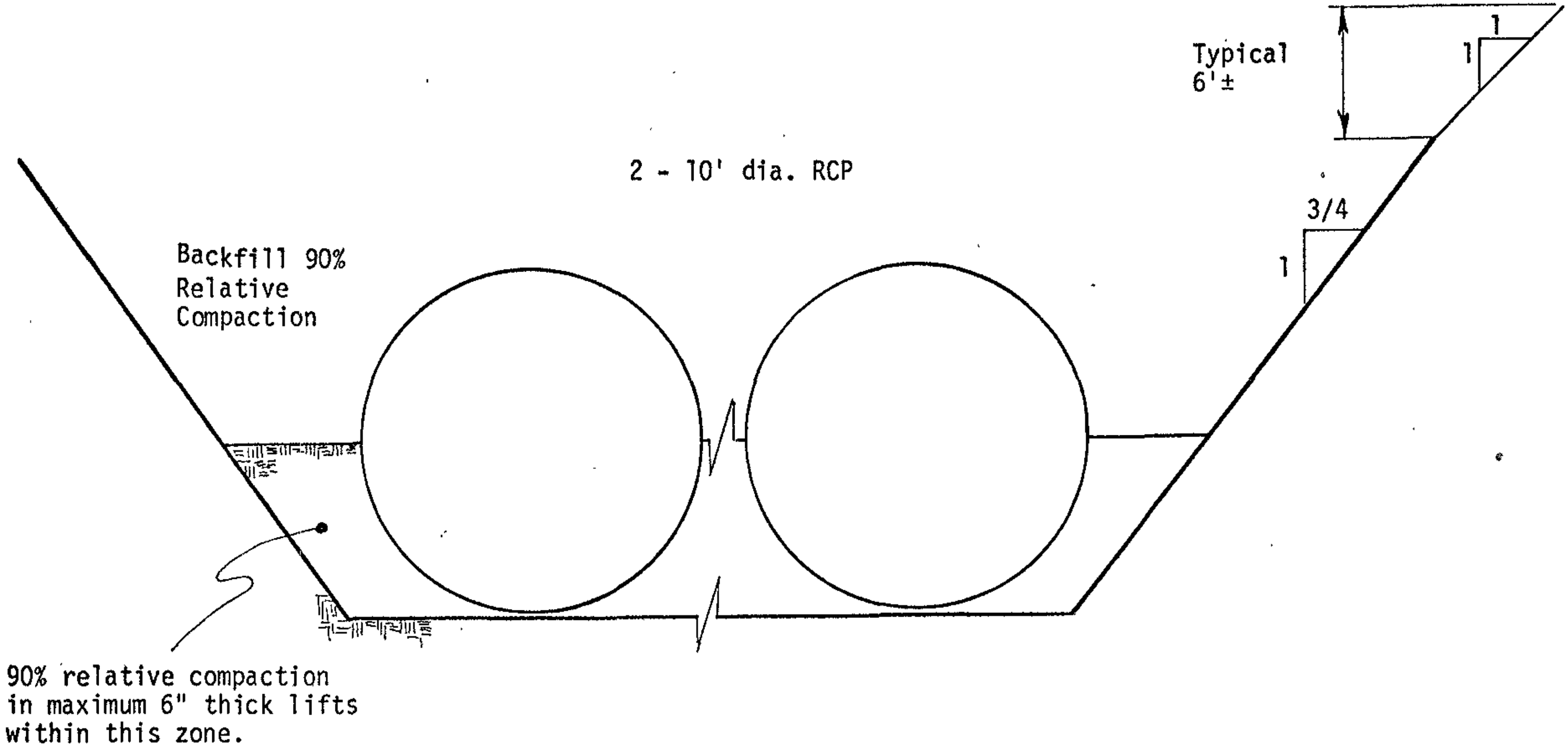


Figure 7

TYPICAL TEMPORARY TRENCH SECTION AND BACKFILL
REQUIREMENTS FOR CUT AND COVER SECTION OF BYPASS PIPES

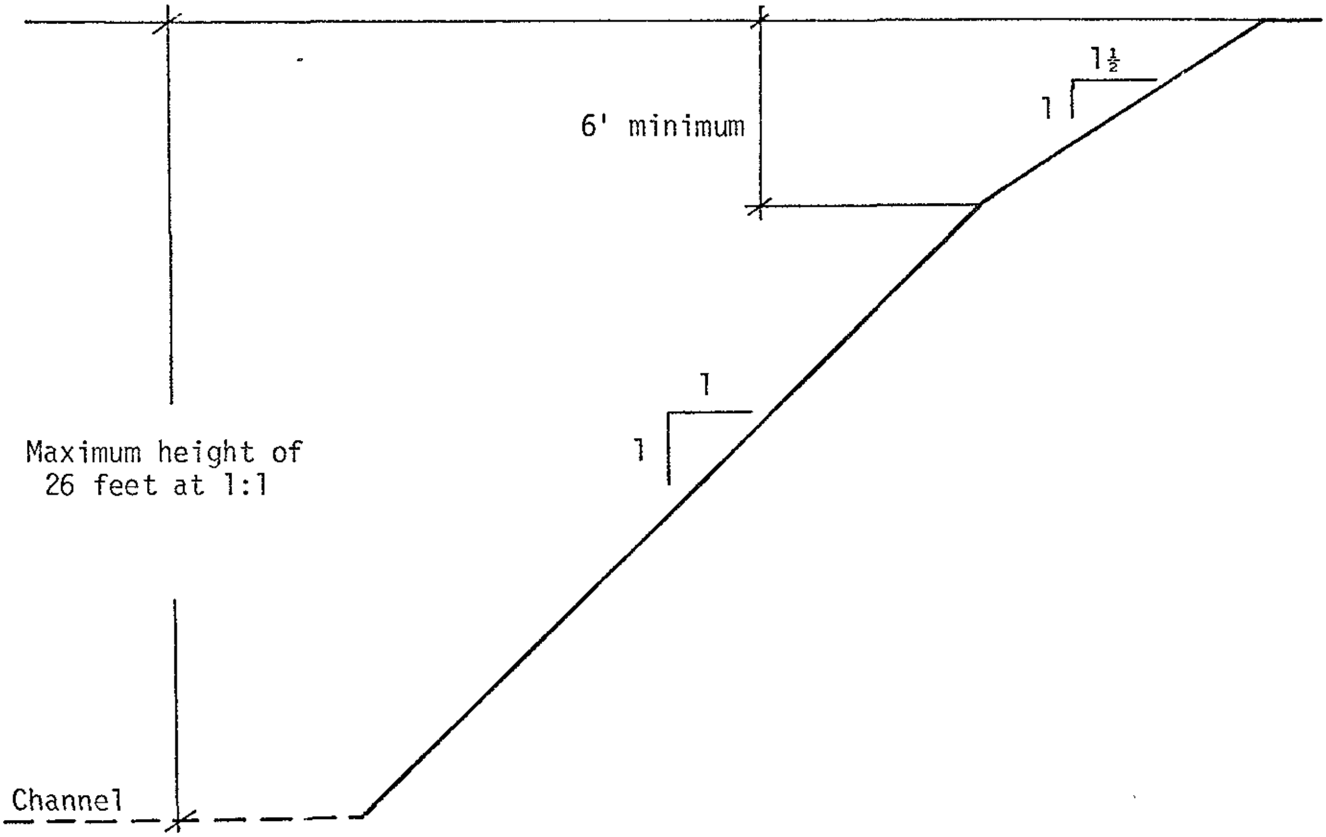
Station 247+80 to 249+00

As any tunnel construction causes discontinuity in the ground mass, surface settlements and the extent of loosening of soils will depend largely on the quality of workmanship and care in installation of both temporary and final support. It follows then, that future settlements cannot be predicted. We recommend that windows be cut through the tops of the pipes after installation to check for possible voids in the materials above the pipe. Excessive voids should be grouted to mitigate settlements over the pipe.

Inlet and outlet diversion channels need to be constructed between the bypass pipes and the existing channel. Figures 8 and 9 (pages 22 and 23), indicate recommended slope and channel details for the diversion channels.

## Construction Observation

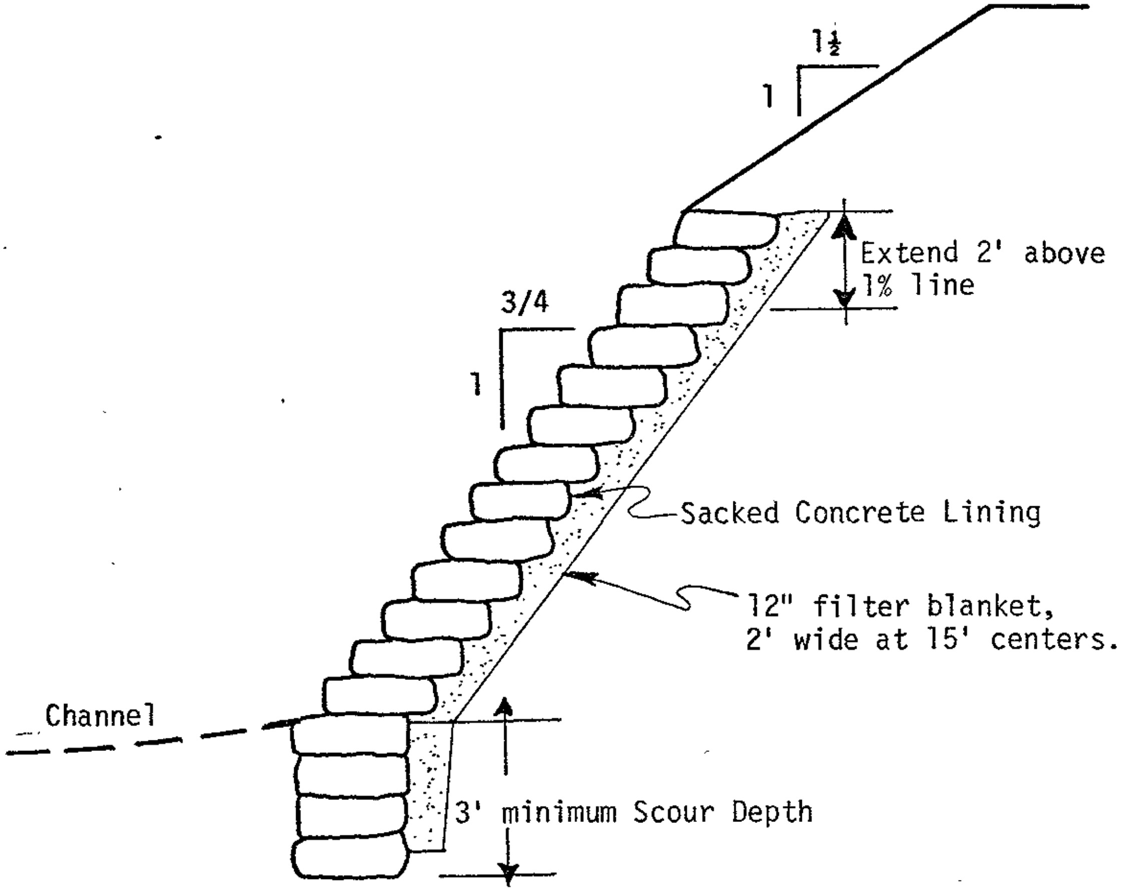
Normal earth work and construction observation and control procedures should be followed to assure that the construction procedures are in accordance with the design requirements and specific recommendations contained in this report.



TYPICAL RECOMMENDED SLOPE WHERE VELOCITIES ARE LESS THAN 5 f.p.s.

Diversion channels for bypass pipes
Approximate Stations 245 to 247+00
and 251+20 to 253

Figure 8



TYPICAL RECOMMENDED SLOPE PROTECTION FOR VELOCITIES GREATER THAN 5 f.p.s.

Diversion channels for bypass pipes
Approximate Stations 245 to 247+00
and 251+20 to 253

Figure 9

## LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, Earth Systems Consultants should be notified so that supplemental recommendations can be given.

2. This report is issued with the understanding that it is the responsibility of the Santa Clara Valley Water District to ensure that the information and recommendations contained herein are incorporated into the plans and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside of our control. Therefore, this report is subject to review and should not be relied upon after a period of three (3) years.

4. This report was prepared upon your request for our services, and in accordance with currently accepted standards of professional soil engineering practice. No warranty based on the contents of this report is intended, and none shall be inferred from the statements or opinions expressed herein.

# APPENDIX A

Key to Logs of Test Borings

Logs of Test Borings

Sampling Location Profiles

Summary of Moisture, Density, Void Ratio, Direct Shear and Unconfined Compression Testing

Summary of Classification Test Results and Remolded Direct Shear

## KEY TO LOGS OF TEST BORINGS

| | |
|---|---|
| ⧄ | 3.0-inch O.D. Modified California Sampler |
| ◫ | Terzaghi Sampler |
| ○ | Pocket Penetrometer Test |
| ☒ | Disturbed or Bulk Sample |
| ▽ | Groundwater Table at time of Drilling |

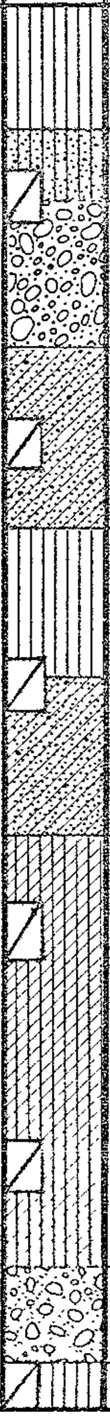
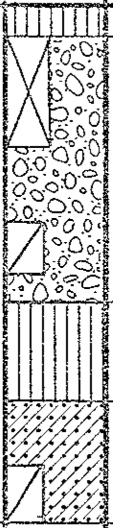
| DEPTH IN FEET | SAMPLE NO. | LOG & LOCATION OF SAMPLE | Penetration Resistance Blows/ft | DESCRIPTION | IN-PLACE | |
|---|---|---|---|---|---|---|
| | | | | | DRY DENSITY p.c.f. | MOISTURE CONTENT % dry wt. |
| | | | | Station 103+70 55 feet left of ℄ | | |
| | | | | Boring 1 - Approx. Elevation 197 feet | | |
| 0 | |  | | Medium brown clayey sandy SILT with minor gravel, dry. (ML) | | |
| | 1-1-1 | | 9/6" | Brown fine gravelly silty fine SAND slightly damp, medium dense. (SM) | 107.8 | 5.4 |
| 5 | 1-1-2 | | 25/6" | Fine to coarse GRAVEL (subround) in clayey silty SAND matrix, dry, dense. (GW-GM) | 120.9 | 4.8 |
| 10 | 1-2 | | 30 | Brown sandy CLAY to clayey SAND, with fine gravel, dense, slightly damp. (CL-SC) | 118.7 | 8.1 |
| | 1-3-1 | | 26 | Yellow-brown sandy clayey SILT, slightly damp, very stiff. (ML) | 109.4 | 10.4 |
| 15 | 1-3-2 | | | Brown clayey fine-medium SAND, non-friable, slightly damp, medium dense. (SC) | 118.3 | 7.4 |
| 20 | 1-4 | | 30 | Medium brown silty CLAY to clayey SILT with fine SAND, slightly damp, hard. (CL-ML) | 126.3 | 10.3 |
| 25 | 1-5 | | 38 | —with abundant gravel | 130.4 | 5.7 |
| | 1-6-1 | | | GRAVEL (½ to 4"), in clayey SAND matrix, slightly damp, dense. (GC) | 120.0 | 7.6 |
| | 1-6-2 | | 26 | Tan clayey sandy SILT, w/gravel, hard,dry. | 130.4 | 5.7 |

Figure A-1 Log of Boring No. 1 (continued next page)



| DEPTH IN FEET | SAMPLE NO. | LOG & LOCATION OF SAMPLE | Penetration Resistance Blows/ft | DESCRIPTION | IN-PLACE DRY DENSITY pcf | IN-PLACE MOISTURE CONTENT % dry wt |
|---|---|---|---|---|---|---|
| | | | | Boring 1 (continued) | | |
| 30 | 1-R-1 | | | Tan gravelly clayey sandy SILT. (ML) | | |
| | 1-7-1<br>1-7-2 | | 31 | ½ to 4" GRAVEL in clayey silty SAND matrix. (GW-GM) | 122.6<br>127.6 | 6.5<br>6.0 |
| 35 | | | | Brown clayey SILT, damp, hard. (ML) | | |
| | 1-8 | | 40 | Yellow-brown clayey silty fine-medium SAND, with occasional gravel, slightly damp, dense. (SC) | 121.5 | 8.0 |
| 40 | | | | Boring terminated at 39.5 feet. Date of drilling August 29, 1980. No groundwater encountered. | | |

Figure A-2 Log of Boring No. 1

File No. CO-0952-C1
October 24, 1980

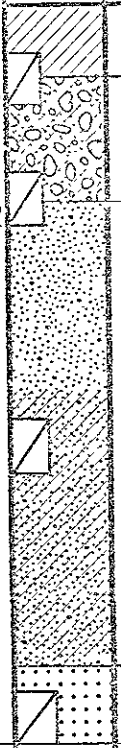
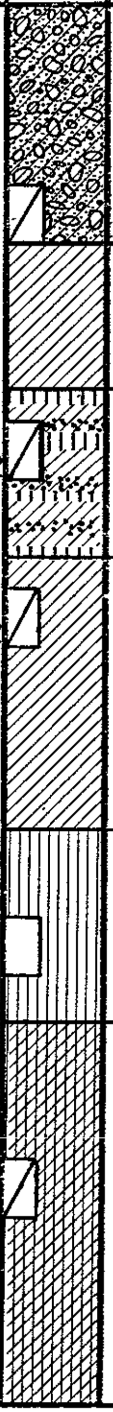
| DEPTH IN FEET | SAMPLE NO | LOG & LOCATION OF SAMPLE | Penetration Resistance Blows/ft | DESCRIPTION | IN-PLACE DRY DENSITY pcf | IN-PLACE MOISTURE CONTENT % dry wt |
|---|---|---|---|---|---|---|
| | | | | Station 104+40 15 feet left of ℄ | | |
| | | | | Boring 2 - Approx. Elevation 165 feet | | |
| 0 | |  | | | | |
| | 2-1-1<br>2-1-2 | | 30 | Tan sandy silty CLAY with abundant gravel, moist, very stiff. (CL) | 128.5<br>126.7 | 11.5<br>11.7 |
| | 2-2-1<br>2-2-2 | | 39 | GRAVEL (½ to 1½") in sandy CLAY matrix, wet, dense. (GC) | 126.6<br>119.4 | 10.9<br>9.5 |
| 5 | | | | Brown well-graded SAND with abundant gravel, slightly clayey, moist, dense. (SW) | | |
| | | | | —clayier (SW-SC) | | |
| | 2-3 | | 19 | —moist to wet, medium dense | 104.4 | 6.5 |
| 10 | | | | | | |
| | 2-4 | | 33 | Brown silty coarse SAND with gravel, moist, dense. (SP) | 126.5 | 7.9 |
| 15 | | | | Boring terminated at 15.0 feet. Date of drilling August 29, 1980. No groundwater encountered. | | |

Figure A-3 Log of Boring No. 2



| DEPTH IN FEET | SAMPLE NO. | LOG & LOCATION OF SAMPLE | Penetration Resistance Blows/ft | DESCRIPTION<br>Station 204+40 60 feet left of ℄ | IN-PLACE DRY DENSITY p.c.f. | IN-PLACE MOISTURE CONTENT % dry wt. |
|---|---|---|---|---|---|---|
| 0 | | | | Boring 3 - Approx. Elevation 123 feet | | |
| 5 | 3-1 | | 13 | Light brown clayey sandy GRAVEL, (1/2 - 4") subround, dry, medium dense. (GC) FILL | 120.5 | 4.6 |
| | | | | Orange-brown silty CLAY, damp, stiff. (CL) | | |
| 10 | 3-2-1<br>3-2-2 | | 12 | Rapidly alternating sequence of orange-brown silty CLAY, clayey fine GRAVEL, clayey sandy SILT, damp, stiff. (CL-GC-ML) 2.5 ○ | 116.4<br>114.5 | 10.0<br>14.2 |
| | 3-3-1<br>3-3-2 | | 12 | Yellow-brown silty CLAY, damp-moist, stiff. (CL) 1.5 ○ | 110.7<br>105.9 | 16.5<br>20.0 |
| 15 | | | | | | |
| 20 | 3-4-1<br>3-4-2 | | 13 | Yellow-brown clayey SILT with sand, abundant fine gravel, damp, stiff. (ML) | 122.5<br>122.5 | 12.2<br>10.2 |
| 25 | 3-5-1<br>3-5-2 | | 15 | Yellow-brown silty CLAY to clayey SILT, with sparse gravel, damp, stiff. (CL-ML) 2.75 ○ | 106.2<br>102.2 | 20.3<br>20.7 |

Figure A-4 Log of Boring No. 3 (continued next page)

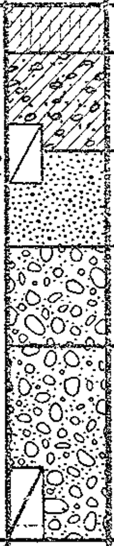
| DEPTH IN FEET | SAMPLE NO. | LOG & LOCATION OF SAMPLE | Penetration Resistance Blows/ft | DESCRIPTION | IN-PLACE | |
|---|---|---|---|---|---|---|
| | | | | | DRY DENSITY pcf | MOISTURE CONTENT % dry wt. |
| | | | | Boring 3 (continued) | | |
| 30 | 3-6-1 |  | 34 | Light brown clayey fine GRAVEL, moist, dense. (GC) | 133.4 | 6.1 |
| | 3-6-2 | | | Tan well-graded SAND with abundant fine-medium gravel, moist, dense. (SW) | 126.2 | 5.1 |
| 35 | | | | Well-graded GRAVEL, moist, dense. (GW-GC) | | |
| | 3-7 | | 26 | Fine to medium GRAVEL in a brown silty sand matrix, moist, medium dense. (GW-GC) | 129.2 | 5.7 |
| 40 | | | | Boring terminated at 40.0 feet. Date of drilling August 29, 1980. No groundwater encountered. | | |

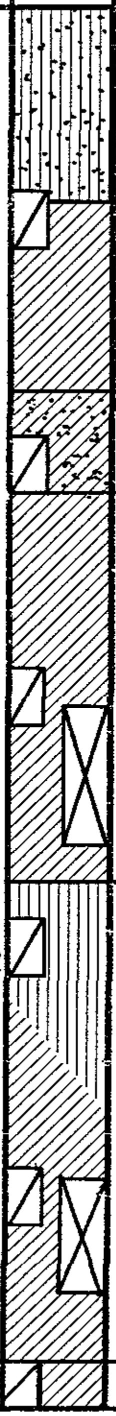
Figure A-5 Log of Boring 3

| DEPTH IN FEET | SAMPLE NO. | LOG & LOCATION OF SAMPLE | Penetration Resistance Blows/ft | DESCRIPTION | IN-PLACE DRY DENSITY p.c.f. | IN-PLACE MOISTURE CONTENT % dry wt. |
|---|---|---|---|---|---|---|
| | | | | Station 237+20 30 feet left of ℄ | | |
| | | | | Boring 4 - Approx. Elevation 90 feet | | |
| 0 | | ▨ | | Dark brown silty CLAY with minor occasional gravel, damp, stiff. (CL)<br>—with caliche, abundant gravel | | |
| 5 | 4-1 | ▨ | 21 | —very stiff ○4.5+ | 112.8 | 17.0 |
| 10 | 4-2 | ▨ | 13 | Yellow-brown silty CLAY, damp, stiff. (CL) ○2.5 | 110.4 | 18.3 |
| 15 | 4-3-1<br>4-3-2 | ▨ | 13 | Yellow-brown clayey SILT to silty CLAY with minor sandy silt layers, damp-moist, stiff. (ML-CL) | 106.6<br>102.6 | 16.7<br>18.5 |
| 20 | 4-4 | ░ | 13 | Yellow-brown silty fine to medium SAND, damp, medium dense. (SM) | 111.3 | 7.4 |
| 25 | 4-5-1<br>4-5-2 | ▨ | 13 | Yellow-brown sandy CLAY with minor clayey sand layers, moist, stiff. (CL) | 103.6<br>98.8 | 22.1<br>21.6 |
| | | | | Boring terminated at 25.0 feet. Date of drilling August 29, 1980. No groundwater encountered. | | |

Figure A-6 Log of Boring No. 4

| DEPTH IN FEET | SAMPLE NO. | LOG & LOCATION OF SAMPLE | Penetration Resistance Blows/ft | DESCRIPTION | IN-PLACE | |
|---|---|---|---|---|---|---|
| | | | | Station 241+85 45 feet right of CL | DRY DENSITY pcf | MOISTURE CONTENT % dry wt. |
| 0 | | | | Boring 5 - Approx. Elevation 80 feet | | |
| | | | | Brown clayey SILT with fine sand, slightly damp, stiff. (ML) | | |
| 5 | 5-1 | | 26 | Medium brown sandy CLAY with minor gravel, slightly damp, very stiff. (CL) 4.5 | 120.6 | 12.3 |
| 10 | 5-2 | | 22 | Yellow-brown clayey fine SAND to sandy CLAY, with caliche, occasional gravel, very stiff, slightly damp. (SC-CL) | 129.4 | 9.5 |
| 15 | 5-3 | | 22 | Yellow-brown sandy CLAY with thin clean sand seams, damp, very stiff. | 117.5 | 10.7 |
| 20 | 5-4 | | 19 | Alternating sequence of yellow-brown silty SAND and sandy SILT, damp, medium dense. (SM-ML) | 111.8 | 7.9 |
| | | | | Boring terminated at 20.0 feet. Date of drilling August 29, 1980. No groundwater encountered. | | |

Figure A-7 Log of Boring No. 5



| DEPTH IN FEET | SAMPLE NO. | Penetration Resistance Blows/ft | DESCRIPTION<br>Station 247+80 75 feet left of ℄ | | IN-PLACE DRY DENSITY p.c.f. | IN-PLACE MOISTURE CONTENT % dry wt. |
|---|---|---|---|---|---|---|
| | | | Boring 6 - Approx. Elevation 85 feet | | | |
| 0 | | | Light brown clayey silty SAND, dry to slightly damp, medium dense. FILL? (SC-SM) | | | |
| 5 | 6-1 | 9 | Medium brown sandy CLAY, damp, stiff, with decayed organics, weathered sandstone clasts. (CL) | 4.5 ○ | 107.8<br>101.6 | 19.8<br>21.6 |
| 10 | 6-2 | 9 | Yellow-brown clayey SAND to sandy CLAY, damp, stiff. (SC-CL) | 4.5 ○ | 113.0 | 14.0 |
| | | | Yellow-brown silty CLAY with fine sand, damp, stiff. (CL) | | | |
| 15 | 6-3 | 12 | —less sand | 3.25 ○ | 98.5 | 24.5 |
| | 6R-1 | | | | | |
| 20 | 6-4-1<br>6-4-2 | 12 | Yellow-brown clayey fine sandy SILT, damp, medium dense. (ML) | | 107.6<br>106.5 | 20.0<br>18.3 |
| | | | Yellow-brown silty CLAY, damp, stiff to very stiff. (CL) | | | |
| | | | —moist | | | |
| 25 | 6-5-1 | 16 | —with fine sand | 1.75 ○ | 98.3 | 25.7 |
| | 6R-2 | | | | | |
| | 6-6 | 19 | Pale yellow silty CLAY (red-brown mottled), damp, very stiff. (CL) | 2.85 ○ | 91.4 | 30.8 |

Figure A-8 Log of Boring 6 (continued next page)

| DEPTH IN FEET | SAMPLE NO. | LOG & LOCATION OF SAMPLE | Penetration Resistance Blows/ft | DESCRIPTION | IN-PLACE | |
|---|---|---|---|---|---|---|
| | | | | | DRY DENSITY pcf | MOISTURE CONTENT % dry wt. |
| | | | | Boring 6 (continued) | | |
| 30 | | ▨ | | Pale yellow silty CLAY. | | |
| | | ▨ | | Yellow-brown fine sandy CLAY, moist, wet, stiff. (CL) | | |
| | 6-7-1 | | 14 | | 91.0 | 31.4 |
| 35 | 6-7-2 | ▨ | | Greenish sandy CLAY, moist, stiff. (CL) | 113.5 | 17.6 |
| | | | | Boring terminated at 35.0 feet. Date of drilling September 12, 1980. No groundwater encountered. | | |

Figure A-9 Log of Boring 6

| DEPTH IN FEET | SAMPLE NO. | LOG & LOCATION OF SAMPLE | Penetration Resistance Blows/ft | DESCRIPTION | IN-PLACE DRY DENSITY pcf | IN-PLACE MOISTURE CONTENT % dry wt. |
|---|---|---|---|---|---|---|
| | | | | Station 251+35 65 feet left of ℄ | | |
| | | | | Boring 7 - Approx. Elevation 81 feet | | |
| 0 | | | | Light brown clayey silty SAND, slightly damp, medium dense. (SM) | | |
| 5 | 7-1 | | 23 | Dark brown sandy CLAY to clayey SAND with abundant gravel (1/4-3/4"), slightly damp, very stiff. (CL-SC) | 99.9 | 10.8 |
| 10 | 7-2-1<br>7-2-2 | | 11 | Yellow-brown silty SAND with minor gravel, caliche, slightly damp, medium dense. (SM) | 127.2<br>117.0 | 8.6<br>9.8 |
| 15 | 7-3<br>7R-1 | | 30 | Yellow-brown fine sandy CLAY to sandy clayey SILT, with caliche, slightly damp, hard. (CL-ML) | 114.9 | 11.6 |
| 20 | 7-4 | | 29 | Orange-grey mottled sandy CLAY with caliche, slightly damp, very stiff. (CL) | 115.4 | 16.2 |
| 25 | 7-5 | | 27 | | 110.9 | 11.4 |
| | | | | —slightly darker orange | | |
| | 7R-2 | | | —with gravel | | |

Figure A-10 Log of Boring 7 (continued next page)

| DEPTH IN FEET | SAMPLE NO. | LOG & LOCATION OF SAMPLE | Penetration Resistance Blows/ft | DESCRIPTION | IN-PLACE | |
|---|---|---|---|---|---|---|
| | | | | | DRY DENSITY pcf | MOISTURE CONTENT % dry wt. |
| | | | | Boring 7 (continued) | | |
| 30 | N.R. | | 30 | Gravelly sandy CLAY, hard. | | |
| | 7-6-1<br>7-6-2 | | 15 | Yellow-brown silty SAND alternating with sandy SILT, moist, medium dense. (SM-ML) | 108.2<br>107.3 | 12.6<br>20.0 |
| 35 | | | | | | |
| | | | | Boring terminated at 35.0 feet. Date of drilling September 12, 1980. No groundwater encountered. | | |

Figure A-11 Log of Boring No. 7

File No. CO-0952-C1
October 24, 1980

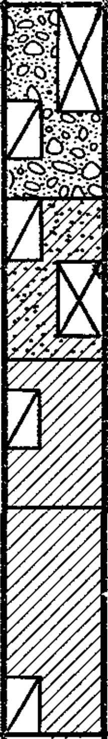
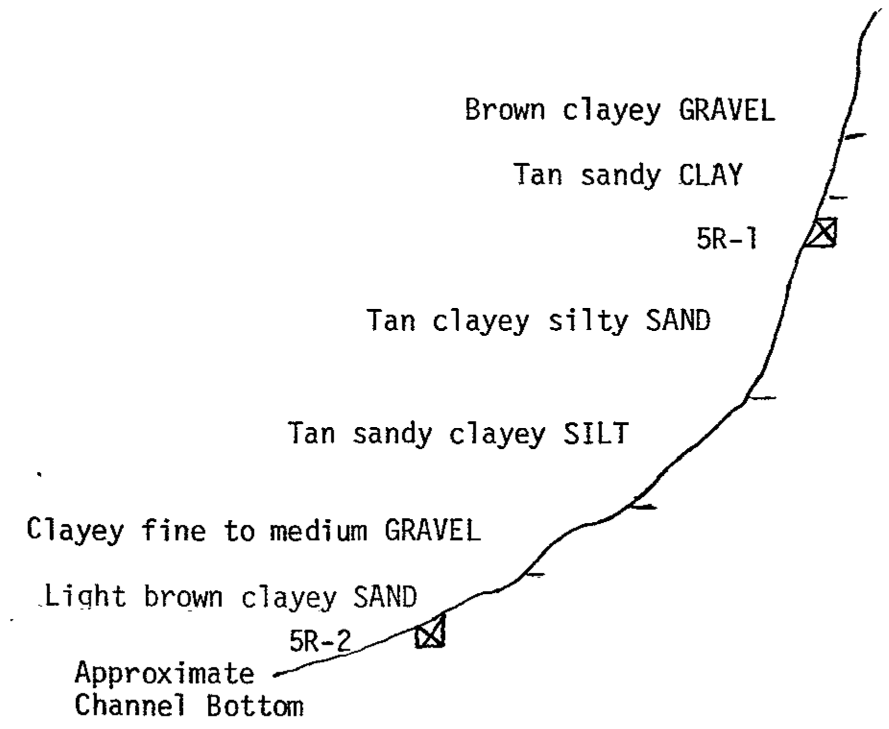
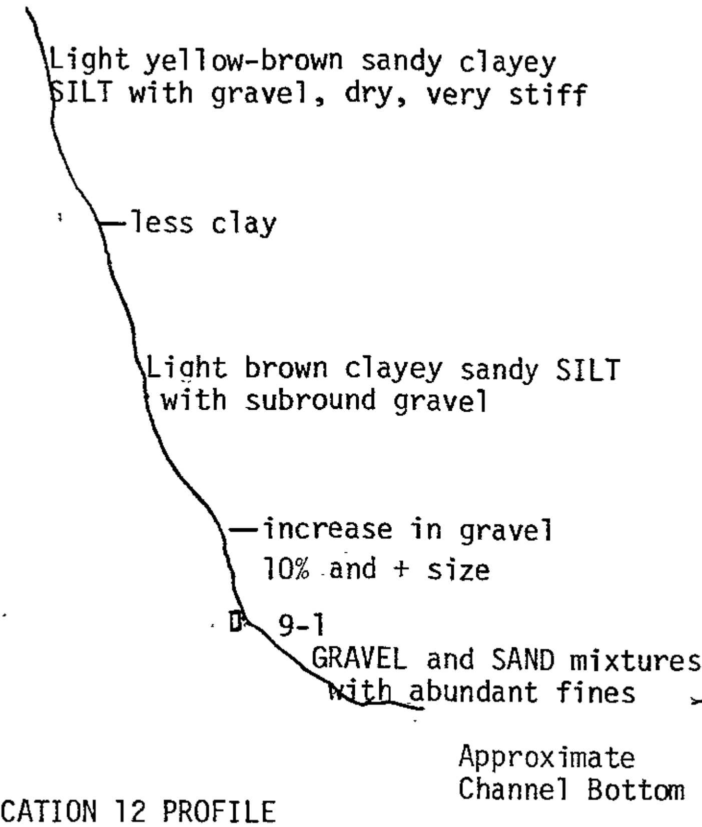
| DEPTH IN FEET | SAMPLE NO. | LOG & LOCATION OF SAMPLE | Penetration Resistance Blows/ft | DESCRIPTION<br>Station 205+00 40 feet left of ℄ | IN-PLACE DRY DENSITY p.c.f. | IN-PLACE MOISTURE CONTENT % dry wt. |
|---|---|---|---|---|---|---|
| 0 | | | | Boring 8 - Approx. Elevation 93 feet | | |
| | 8R-1<br>8-1 |  | | Grey-brown sandy well-graded GRAVEL, to gravelly SAND, damp, loose. (GW-SW)<br>—wet ∇ | 91.1 | 28.9 |
| 5 | 8-2<br>8R-2 | | | Orange-brown clayey SAND, wet, medium dense. (SC) | 103.8 | 22.3 |
| | 8-3 | | | Orange-brown sandy CLAY, moist, stiff. (CL) | 107.8 | 16.2 |
| 10<br>15 | 8-4 | | | Olive silty CLAY, damp, very stiff. (CL) | 100.1 | 24.7 |
| | | | | Boring terminated at 15.0 feet. Date of drilling September 12, 1980 | | |

Figure A-12 Log of Boring 8

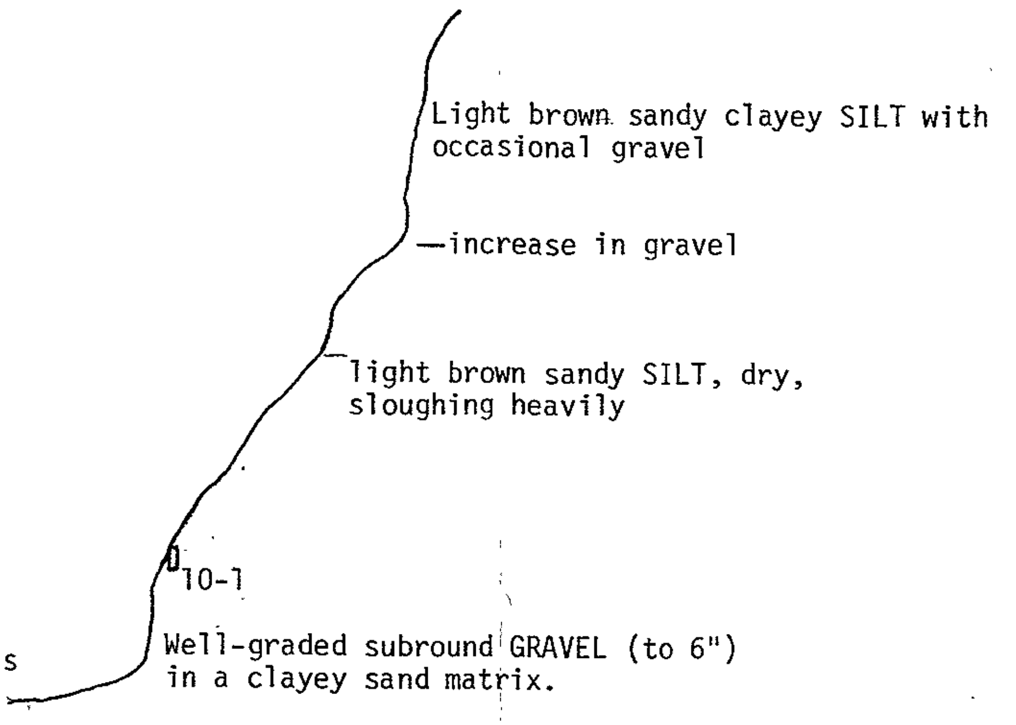
SAMPLING LOCATION 5A PROFILE
STATION 236+00, EAST BANK



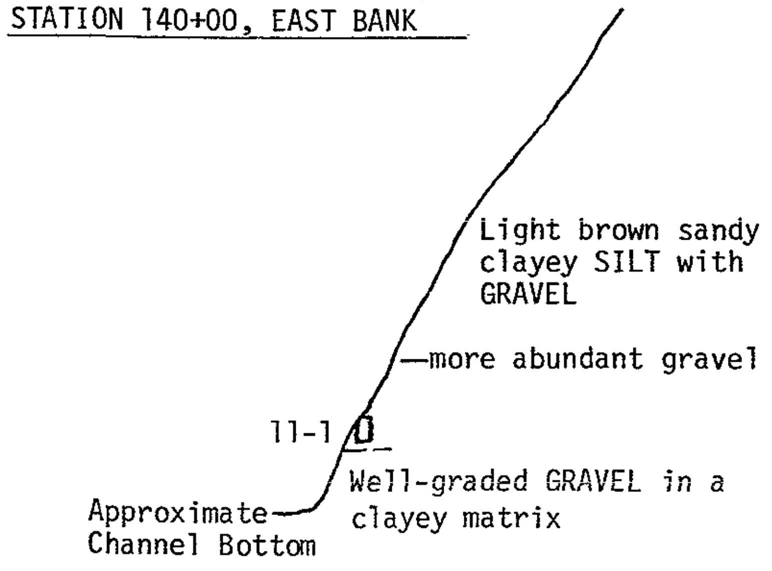
SAMPLING LOCATION 9 PROFILE
STATION 133+75, WEST BANK


Light yellow-brown sandy clayey SILT with gravel, dry, very stiff
less clay
Light brown clayey sandy SILT with subround gravel
increase in gravel 10% and + size
9-1
GRAVEL and SAND mixtures with abundant fines
Approximate
Channel Bottom

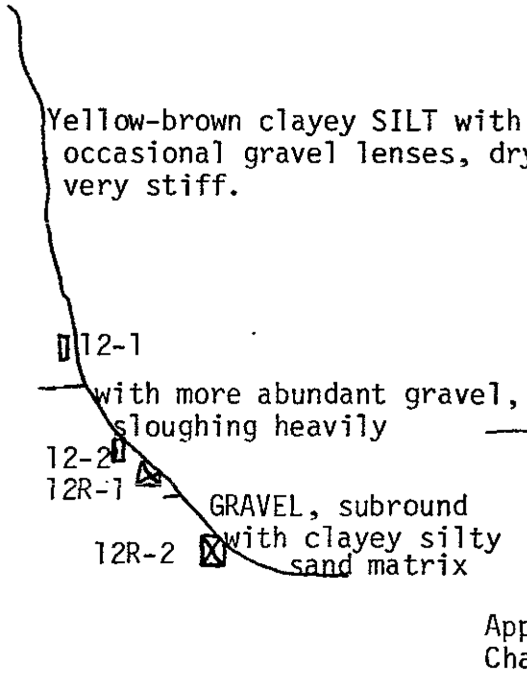
SAMPLING LOCATION 10 PROFILE
STATION 132+00, EAST BANK


Light brown sandy clayey SILT with occasional gravel
increase in gravel
light brown sandy SILT, dry, sloughing heavily
10-1
Well-graded subround GRAVEL (to 6") in a clayey sand matrix.

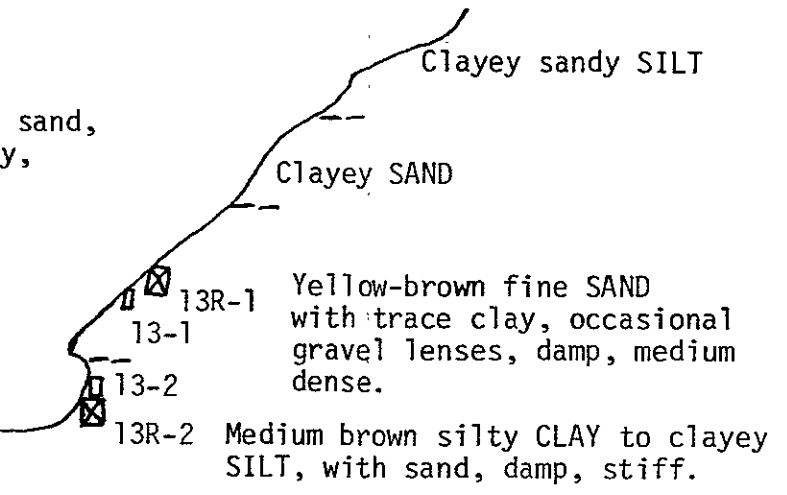
SAMPLING LOCATION 11 PROFILE
STATION 140+00, EAST BANK


Light brown sandy clayey SILT with GRAVEL
more abundant gravel
11-1
Well-graded GRAVEL in a clayey matrix
Approximate
Channel Bottom

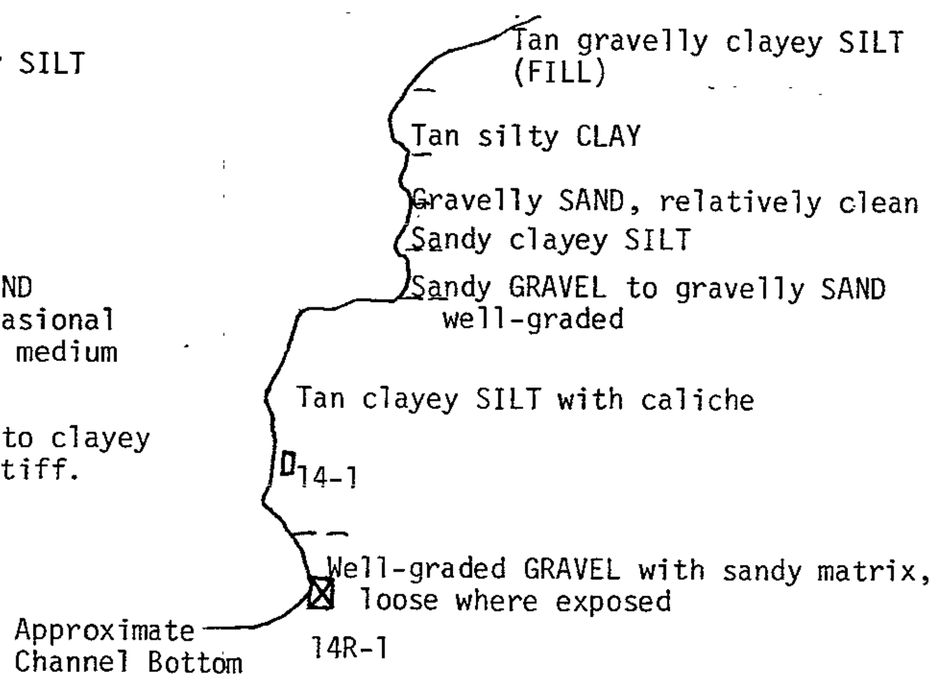
SAMPLING LOCATION 12 PROFILE
STATION 149+50, WEST BANK


Yellow-brown clayey SILT with sand, occasional gravel lenses, dry, very stiff.
12-1
with more abundant gravel, sloughing heavily
12-2
12R-1
GRAVEL, subround with clayey silty sand matrix
12R-2
Approximate
Channel Bottom

SAMPLING LOCATION 13 PROFILE
STATION 228+50, EAST BANK


Clayey sandy SILT
Clayey SAND
13R-1
13-1
Yellow-brown fine SAND with trace clay, occasional gravel lenses, damp, medium dense.
13-2
13R-2
Medium brown silty CLAY to clayey SILT, with sand, damp, stiff.

SAMPLING LOCATION 14 PROFILE
STATION 38+25, EAST BANK

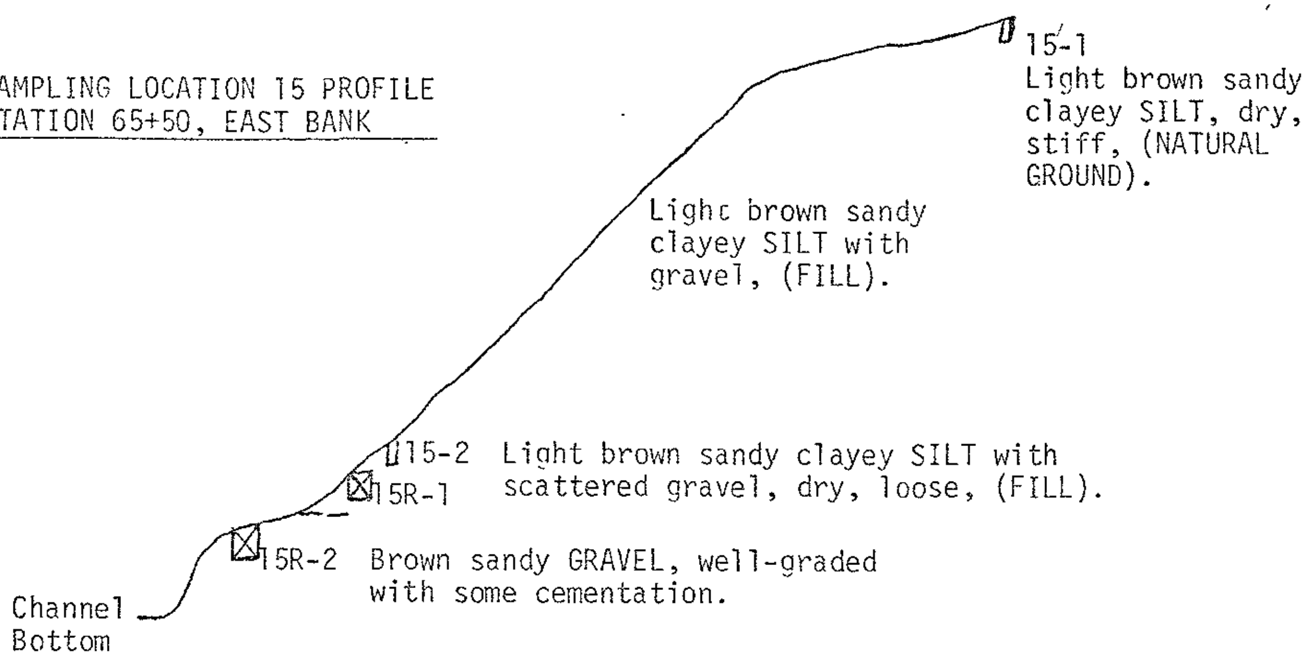

Tan gravelly clayey SILT (FILL)
Tan silty CLAY
Gravelly SAND, relatively clean
Sandy clayey SILT
Sandy GRAVEL to gravelly SAND well-graded
Tan clayey SILT with caliche
14-1
Well-graded GRAVEL with sandy matrix, loose where exposed
Approximate
Channel Bottom
14R-1

SCALE 1" = 5'

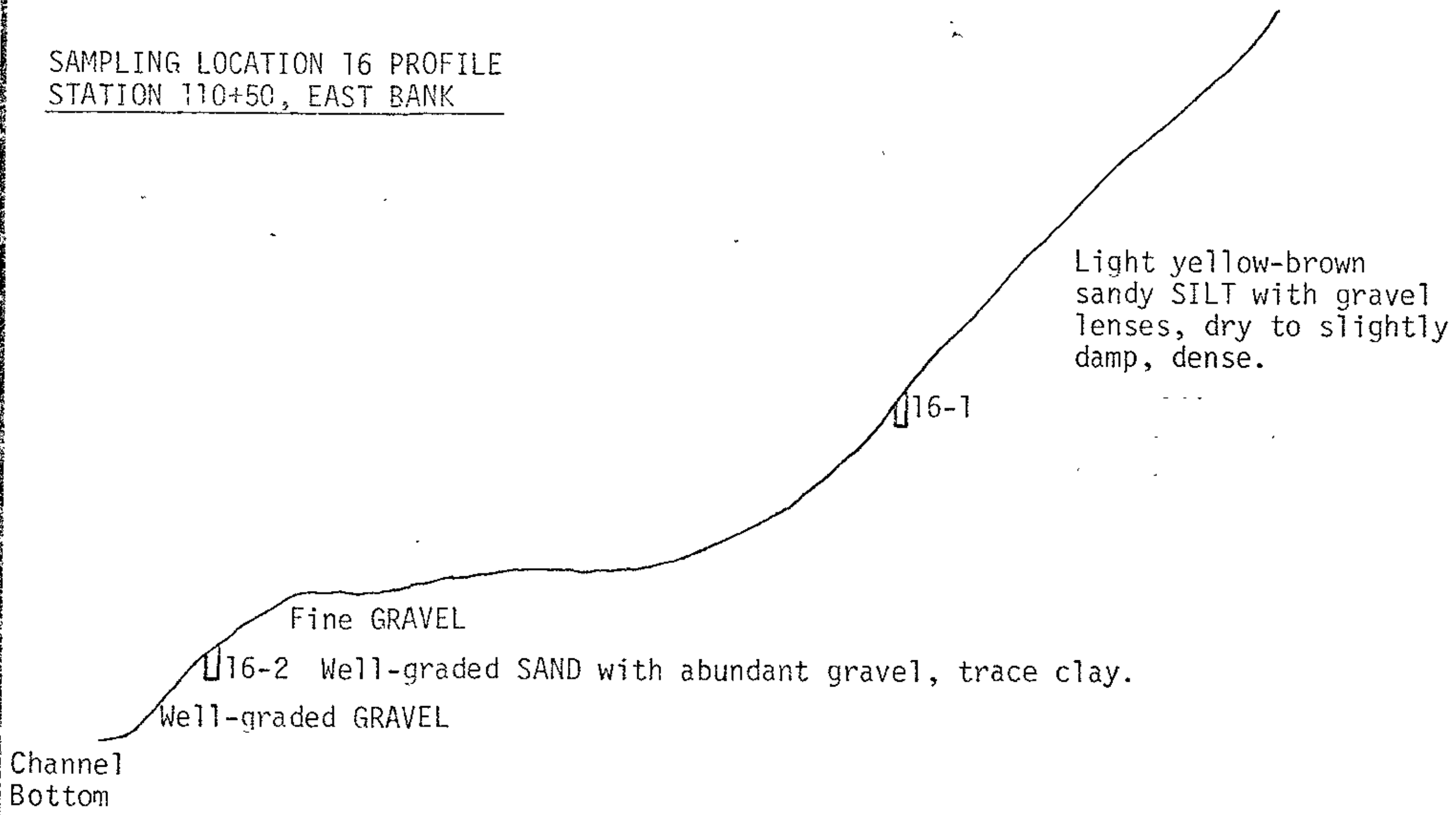
Note: All Profiles are North-Facing Views.

Figure A-13

SAMPLING LOCATION 15 PROFILE
STATION 65+50, EAST BANK


15-1
Light brown sandy clayey SILT, dry, stiff, (NATURAL GROUND).
Light brown sandy clayey SILT with gravel, (FILL).
15-2
Light brown sandy clayey SILT with scattered gravel, dry, loose, (FILL).
15R-1
15R-2
Brown sandy GRAVEL, well-graded with some cementation.
Channel Bottom

SAMPLING LOCATION 16 PROFILE
STATION 110+50, EAST BANK


Light yellow-brown sandy SILT with gravel lenses, dry to slightly damp, dense.
16-1
Fine GRAVEL
16-2
Well-graded SAND with abundant gravel, trace clay.
Well-graded GRAVEL
Channel Bottom

Scale 1" = 5'

Figure A-14

## Table A-1

### Summary of Moisture, Density, Void Ratio, Direct Shear and Unconfined Compression Testing

| | | In-Place Conditions | | | Direct Shear and Unconfined Compression Testing | | |
|---|---|---|---|---|---|---|---|
| Sample Number | Depth (ft.) | Dry Density pcf | Moisture Content % Dry Wt. | Void Ratio (A) | Unconfined Compression psf | Angle of Internal Friction degrees | Unit Cohesion psf |
| 1-1-1 | 3.5 | 107.8 | 5.4 | .563 | | | |
| 1-1-2 | 4.0 | 120.9 | 4.8 | .394 | | | |
| 1-2 | 8.5 | 118.7 | 8.1 | .419 | | 25.0 | 840 |
| 1-3-1 | 13.5 | 109.4 | 10.4 | .540 | | | |
| 1-3-2 | 14.0 | 118.3 | 7.4 | .424 | 14,558 | | |
| 1-4 | 18.5 | 126.3 | 10.3 | .334 | 28,757 | | |
| 1-5 | 23.5 | 130.2 | 9.2 | .294 | 34,050 | | |
| 1-6-1 | 28.5 | 120.0 | 7.6 | .404 | | 33.0 | 200 |
| 1-6-2 | 29.5 | 130.4 | 5.7 | .293 | | | |
| 1-7-1 | 33.5 | 122.6 | 6.5 | .374 | | | |
| 1-7-2 | 34.0 | 127.6 | 6.0 | .320 | | | |
| 1-8 | 38.5 | 121.5 | 8.0 | .387 | | | |
| 2-1-1 | 1.0 | 128.5 | 11.5 | .311 | | | |
| 2-1-2 | 1.5 | 126.7 | 11.7 | .330 | | 42.5 | 760 |
| 2-2-1 | 3.5 | 126.6 | 10.9 | .331 | | | |
| 2-2-2 | 4.0 | 119.4 | 9.5 | .411 | | 40.0 | 425 |
| 2-3 | 8.5 | 104.4 | 6.5 | .614 | | | |
| 2-4 | 14.0 | 126.5 | 7.9 | .332 | | | |
| 3-1 | 3.5 | 120.5 | 4.6 | .398 | | | |
| 3-2-1 | 8.5 | 116.4 | 10.0 | .447 | | | |
| 3-2-2 | 9.0 | 114.5 | 14.2 | .471 | 3,499 | | |
| 3-3-1 | 13.5 | 110.7 | 16.5 | .522 | | | |
| 3-3-2 | 14.0 | 105.9 | 20.0 | .533 | | 21.0 | 310 |
| 3-4-1 | 18.5 | 122.5 | 12.2 | .375 | | 24.0 | 980 |
| 3-4-2 | 19.0 | 122.5 | 10.2 | .375 | | | |
| 3-5-1 | 24.0 | 106.2 | 20.3 | .586 | | | |
| 3-5-2 | 24.5 | 102.2 | 20.7 | .648 | | | |
| 3-6-1 | 31.5 | 133.4 | 6.1 | .263 | | | |
| 3-6-2 | 32.0 | 126.2 | 5.1 | .335 | | | |
| 3-7 | 39.0 | 129.2 | 5.7 | .304 | | | |

Notes: (A) - Based on tested specific gravity of 2.70 from 1R-1 and 8R-1.
(B) - Single Point Reshear.
(C) - Recycle Direct Shear Peak - Residual.

## Table A-1 (continued)

### Summary of Moisture, Density, Void Ratio, Direct Shear and Unconfined Compression Testing

| | | In-Place Conditions | | | Direct Shear and Unconfined Compression Testing | | |
|---|---|---|---|---|---|---|---|
| Sample Number | Depth (ft.) | Dry Density pcf | Moisture Content % Dry Wt. | Void Ratio (A) | Unconfined Compression psf | Angle of Internal Friction degrees | Unit Cohesion psf |
| 4-1 | 3.5 | 112.8 | 17.0 | .494 | 10,601 | | |
| 4-2 | 8.5 | 110.4 | 18.3 | .526 | 5,191 | | |
| 4-3-1 | 13.5 | 106.6 | 16.7 | .580 | | 12.0 | 1,050 |
| 4-3-2 | 14.0 | 102.6 | 18.5 | .642 | | | |
| 4-4 | 19.0 | 111.3 | 7.4 | .514 | | | |
| 4-5-1 | 24.0 | 103.6 | 22.1 | .626 | | 9.0 | 770 |
| 4-5-2 | 24.5 | 98.8 | 21.6 | .705 | | | |
| 5-1 | 3.5 | 120.6 | 12.3 | .397 | 18.573 | | |
| 5-2 | 8.5 | 129.4 | 9.5 | .302 | 22,663 | | |
| 5-3 | 13.5 | 117.5 | 10.7 | .434 | | | |
| 5-4 | 19.0 | 111.8 | 7.9 | .514 | | 33.0 | 175 |
| 6-1-1 | 3.5 | 107.8 | 19.8 | .563 | | 18.0 (B) | 1,330 |
| 6-1-2 | 4.0 | 101.6 | 21.6 | .658 | | 22.0 (B) | 950 |
| 6-2 | 8.5 | 113.0 | 14.0 | .491 | | 27.0 (B) | 580 |
| 6-3 | 13.5 | 98.5 | 24.5 | .710 | | 15.5 (B) | 370 |
| 6-4-1 | 18.5 | 107.6 | 20.0 | .566 | | 33-33 (C) | 250-40 |
| 6-4-2 | 19.0 | 106.5 | 18.3 | .582 | | | |
| 6-5 | 24.0 | 98.3 | 75.7 | .714 | 2,625 | | |
| 6-6 | 28.5 | 91.9 | 30.8 | .843 | 4,677 | | |
| 6-7-1 | 33.5 | 91.0 | 31.4 | .851 | 2,510 | | |
| 6-7-2 | 34.0 | 113.5 | 17.6 | .484 | | | |
| 7-1 | 3.5 | 99.9 | 10.8 | .686 | | 27.0 (B) | 120 |
| 7-2-1 | 8.5 | 127.2 | 8.6 | .325 | 23,400 | | |
| 7-2-2 | 9.0 | 117.0 | 9.8 | .440 | | 12.0 (B) | 1,200 |
| 7-3 | 13.5 | 114.9 | 11.6 | .466 | | 22.5 (B) | 500 |
| 7-4 | 18.5 | 115.4 | 16.2 | .460 | | 12.0 (B) | 1,050 |
| 7-5 | 23.5 | 110.4 | 11.4 | .526 | 3,287 | | |
| 7-6-1 | 33.5 | 108.2 | 12.6 | .557 | | | |
| 7-6-2 | 34.0 | 107.3 | 20.0 | .570 | | | |
| 8-1 | 1.5 | 91.1 | 28.9 | .849 | | | |
| 8-2 | 4.0 | 103.8 | 22.3 | .623 | | 25.0 | 550 |
| 8-3 | 8.0 | 107.8 | 16.2 | .563 | | | |
| 8-4 | 14.0 | 100.1 | 24.7 | .683 | | | |

## Table A-1 (continued)

### Summary of Moisture, Density, Void Ratio, Direct Shear and Unconfined Compression Testing

| | | In-Place Conditions | | | Direct Shear and Unconfined Compression Testing | | |
|---|---|---|---|---|---|---|---|
| Sample Number | Depth (ft.) | Dry Density pcf | Moisture Content % Dry Wt. | Void Ratio (A) | Unconfined Compression psf | Angle of Internal Friction degrees | Unit Cohesion psf |
| 9-1 | | 104.3 | 3.2 | .615 | | 30.0 | 175 |
| 10-1 | | 116.2 | 6.1 | .450 | | 29.0 | 400 |
| 11-1 | | 121.1 | 10.5 | .391 | | 21.0 | 890 |
| 12-1 | | 101.6 | 5.6 | .658 | | 25.0 | 140 |
| 12-2 | | 102.6 | 5.0 | .642 | | 23.0 | 250 |
| 13-1 | | 106.1 | 10.0 | .588 | | | |
| 13-2 | | 104.8 | 19.6 | .608 | | 6.0 | 1,050 |
| 14-1A | | 107.3 | 7.4 | .570 | | 15.0 | 500 |
| 15-1 | | 79.4 | 3.6 | 1.122 | | | |
| 15-2 | | 86.1 | 3.5 | .957 | | | |
| 16-1 | | 105.8 | 9.4 | .592 | | 38.0 | 50 |
| 16-2 | | 99.2 | 6.2 | .698 | | 26.0 | 140 |

## Table A-2

### Summary of Classification Test Results and Remolded Direct Shear

| SAMPLE IDENTIFICATION: | 1R-1 | 5R-2 | 6R-1 | 8R-1 | 12R-2 | 13R-2 | 14R-1 |
|---|---|---|---|---|---|---|---|
| SOIL CLASSIFICATION: | GC-SC | SC | CL | GW-SW | GW-SW | CL | GW |
| BORING NUMBER: | 1 | 5A | 8 | 8 | 12 | 13 | 14 |
| DEPTH, FEET: | 30-32 | 16-18 | 14-17 | 0-2 | 28-30 | 8-9 | 13-14 |
| MAXIMUM DENSITY, P.S.F.: | -- | -- | -- | -- | -- | -- | -- |
| OPTIMUM MOISTURE, %: | -- | -- | -- | -- | -- | -- | -- |
| GRAIN-SIZE DISTRIBUTION | | | | | | | |
| GRAVEL (5mm): | 49.7 | 2.1 | 0.0 | 43.3 | 51.1 | 0.0 | 84.5 |
| SAND (73 micron): | 41.7 | 72.7 | 21.7 | 55.9 | 41.4 | 27.8 | 11.7 |
| SILT AND CLAY: | 8.6 | 25.2 | 51.3 & 27.0 | 0.8 | 7.8 | 72.2 | 3.8 |
| LIQUID LIMIT: | -- | 18.4 | -- | -- | -- | -- | -- |
| PLASTIC LIMIT: | -- | N.P. | -- | -- | -- | -- | -- |
| PLASTICITY INDEX: | -- | N.P. | -- | -- | -- | -- | -- |
| DIRECT SHEAR | | | | | | | |
| ANGLE OF FRICTION: | -- | -- | -- | -- | -- | -- | -- |
| COHESION, P.S.F.: | -- | -- | -- | -- | -- | -- | -- |
| SPECIFIC GRAVITY: | 2.70 | 2.62 | -- | 2.70 | -- | -- | -- |

## Table A-2 (continued)

## Summary of Classification Test Results and Remolded Direct Shear

| | | | |
|---|---|---|---|
| SAMPLE IDENTIFICATION: | 15R-1 | 2-1-2 | 8-2 |
| SOIL CLASSIFICATION: | SC | SC | SM |
| BORING NUMBER: | 15 | 2 | 8 |
| DEPTH, FEET: | 12-13 | 1.5 | 4.0 |
| MAXIMUM DENSITY, P.S.F.: | 123.8 * | -- | -- |
| OPTIMUM MOISTURE, %: | 11.6 * | -- | -- |
| GRAIN-SIZE DISTRIBUTION | | | |
| GRAVEL (5mm): | -- | -- | -- |
| SAND (73 micron): | -- | -- | -- |
| SILT AND CLAY: | -- | -- | -- |
| LIQUID LIMIT: | -- | 21.9 | 20.9 |
| PLASTIC LIMIT: | -- | 17.0 | N.P. |
| PLASTICITY INDEX: | -- | 5.0 | N.P. |
| DIRECT SHEAR | | | |
| ANGLE OF FRICTION: | 25.0 | -- | -- |
| COHESION, P.S.F.: | 610 | -- | -- |
| SPECIFIC GRAVITY: | -- | -- | -- |

*ASTM D1557-70 Method A.